

WHAT IS CLAIMED IS:

1. An optical transmission apparatus for transmitting an optical pulse string having a frequency two times that of a driving signal, said optical transmission apparatus  
5 comprising:

a Mach-Zehnder optical modulator;

a light source which inputs an optical signal into said optical modulator;

a driving unit which inputs the driving signal into  
10 the optical modulator;

a converting unit which takes out a part of an optical signal output from said optical modulator and converts that part of the optical signal into electric signal;

an extracting unit which extracts a frequency  
15 component of the driving signal included in the electric signal converted by said converting unit;

an error signal generating unit which generates an error signal of a bias voltage for minimizing a value of a frequency component of the driving signal extracted by  
20 said extracting unit; and

a bias voltage control unit which applies a bias voltage obtained as a result of addition of the bias voltage and a voltage corresponding to the error signal to said optical modulator.

2. The optical transmission apparatus according to claim  
1, wherein

said light source generates a modulated optical pulse  
synchronous with the driving signal and having a bit rate  
5 two times that of the driving signal, and supplies the optical  
pulse to said optical modulator, and

said optical modulator pulse modulates the optical  
pulse with the driving signal and outputs the modulated  
optical pulse.

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3. The optical transmission apparatus according to claim  
1, wherein said light source includes a plurality of  
single-wavelength light sources each of which emits light  
having different single-wavelength,

15 said optical transmission apparatus further  
comprising an optical filter, provided at the front stage  
of said converting unit, which transmits light having only  
a desired wavelength out of the lights having different  
wavelength emitted by said single-wavelength light sources  
20 that constitute an optical signal output from said optical  
modulator.

4. The optical transmission apparatus according to claim  
1 further comprising a dither signal generating unit which  
25 generates a dither signal that is input into the error signal

generating unit and the bias voltage control unit, wherein

5       said error signal generating unit carries out a  
synchronous detection by multiplying a dither signal to a  
frequency component of a driving signal or a frequency  
component two times that of the driving signal extracted  
by said extracting unit, and outputs a result of this  
synchronous detection to the bias voltage control unit as  
an error signal of the bias voltage, and

10       said bias voltage control unit applies to said optical  
modulator a signal obtained by superimposing the error signal  
of the bias voltage with the bias voltage and the dither  
signal.

5.       An optical transmission apparatus for transmitting  
15       an optical pulse string having a frequency two times that  
of a driving signal, said optical transmission apparatus  
comprising:

      a Mach-Zehnder optical modulator;

20       a light source which inputs an optical signal into  
said optical modulator;

      a driving unit which inputs the driving signal into  
said optical modulator;

      a converting unit which takes out a part of an optical  
signal output from said optical modulator and converts that  
25       part of the optical signal into electric signal;

an extracting unit which extracts a frequency component two times that of the driving signal included in the electric signal converted by said converting unit;

an error signal generating unit which generates an  
5 error signal of a bias voltage for maximizing a value of the frequency component two times that of the driving signal extracted by said extracting unit; and

a bias voltage control unit which applies a bias voltage added with an error signal of the bias voltage to said optical  
10 modulator.

6. The optical transmission apparatus according to claim 5, wherein

said light source generates a modulated optical pulse  
15 synchronous with the driving signal and having a bit rate two times that of the driving signal, and supplies the optical pulse to said optical modulator, and

said optical modulator pulse modulates the optical pulse with the driving signal and outputs the modulated  
20 optical pulse.

7. The optical transmission apparatus according to claim 5, wherein said light source includes a plurality of single-wavelength light sources each of which emits light  
25 having different single-wavelength,

said optical transmission apparatus further comprising an optical filter, provided at the front stage of said converting unit, which transmits light having only a desired wavelength out of the lights having different wavelength emitted by said single-wavelength light sources that constitute an optical signal output from said optical modulator.

8. The optical transmission apparatus according to claim 5 further comprising a dither signal generating unit which generates a dither signal that is input into the error signal generating unit and the bias voltage control unit, wherein

said error signal generating unit carries out a synchronous detection by multiplying a dither signal to a frequency component of a driving signal or a frequency component two times that of the driving signal extracted by said extracting unit, and outputs a result of this synchronous detection to the bias voltage control unit as an error signal of the bias voltage, and

said bias voltage control unit applies to said optical modulator a signal obtained by superimposing the error signal of the bias voltage with the bias voltage and the dither signal.

9. A bias voltage control method for an optical modulator to be used for an optical transmission apparatus that inputs an optical signal into a Mach-Zehnder optical modulator, applies a driving signal and a bias voltage to said optical  
5 modulator, and transmits an optical pulse string having a frequency two times that of the driving signal, the method comprising the steps of:

taking out a part of an optical signal output from said optical modulator and converting that part of the  
10 optical signal into electric signal;

extracting a frequency component of the driving signal from the obtained electric signal;

generating an error signal of a bias voltage for minimizing a value of the frequency component of the driving  
15 signal; and

applying a bias voltage obtained as a result of addition of the bias voltage and a voltage corresponding to the error signal to said optical modulator.

20 10. A bias voltage control method for an optical modulator to be used for an optical transmission apparatus that inputs an optical signal into a Mach-Zehnder optical modulator, applies a driving signal and a bias voltage to said optical modulator, and transmits an optical pulse string having a  
25 frequency two times that of the driving signal, the method

comprising the steps of:

taking out a part of an optical signal output from said optical modulator and converting that part of the optical signal into electric signal;

5 extracting a frequency component two times that of the driving signal from the obtained electric signal;

generating an error signal of a bias voltage for maximizing a value of the frequency component two times that of the driving signal; and

10 applying a bias voltage obtained as a result of addition of the bias voltage and a voltage corresponding to the error signal to said optical modulator.